UT-BATTELLE

Energy Star Appliances and beyond; a critical component of zero energy houses

Jeff Christian, ORNL

Rich Karney, DOE

Energy Star Appliance Partners

Meeting 2

Oct 4, 2004

OAK RIDGE NATIONAL LABORATORY
U. S. DEPARTMENT OF ENERGY

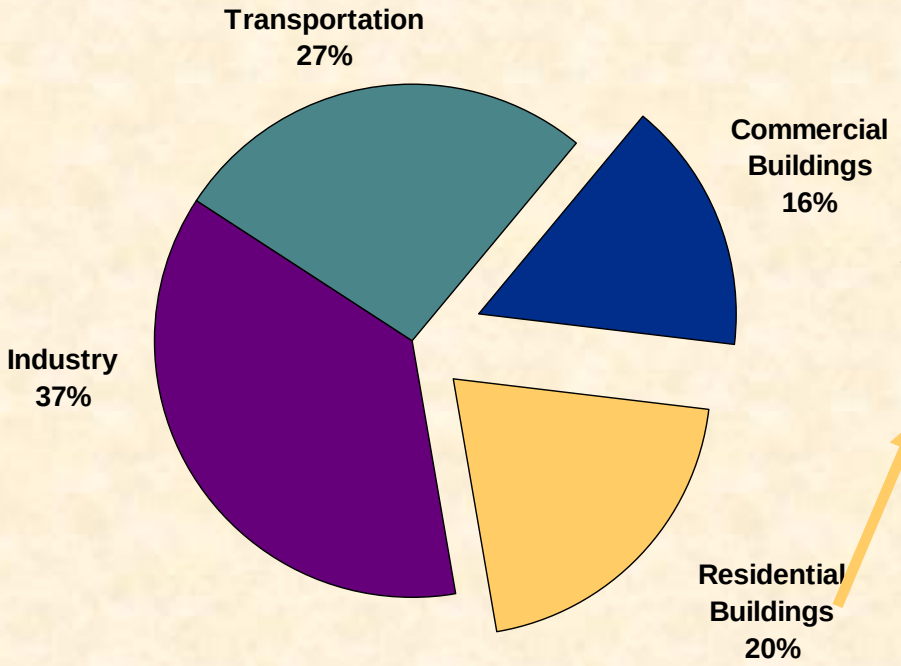
Drop-In Residential Heat Pump Water Heater, R&D 100 award winner

FRIDGE OF THE FUTURE

4 Affordable Near Net Zero Energy Houses built and occupied near ORNL

- **ZEH 1 annual measured heating cost $92, cooling $74 with an air source heat pump, and DHW $90**
- **45 cents per day space heating and cooling energy**
- **82 cents cost of off site total energy**

Where energy is used



	National	Res. Avg. ZEH1
Space Heating	33%	14%
Space Cooling	10%	11%
Water Heating	15%	14%
Other	42%	**61%**

Sources:

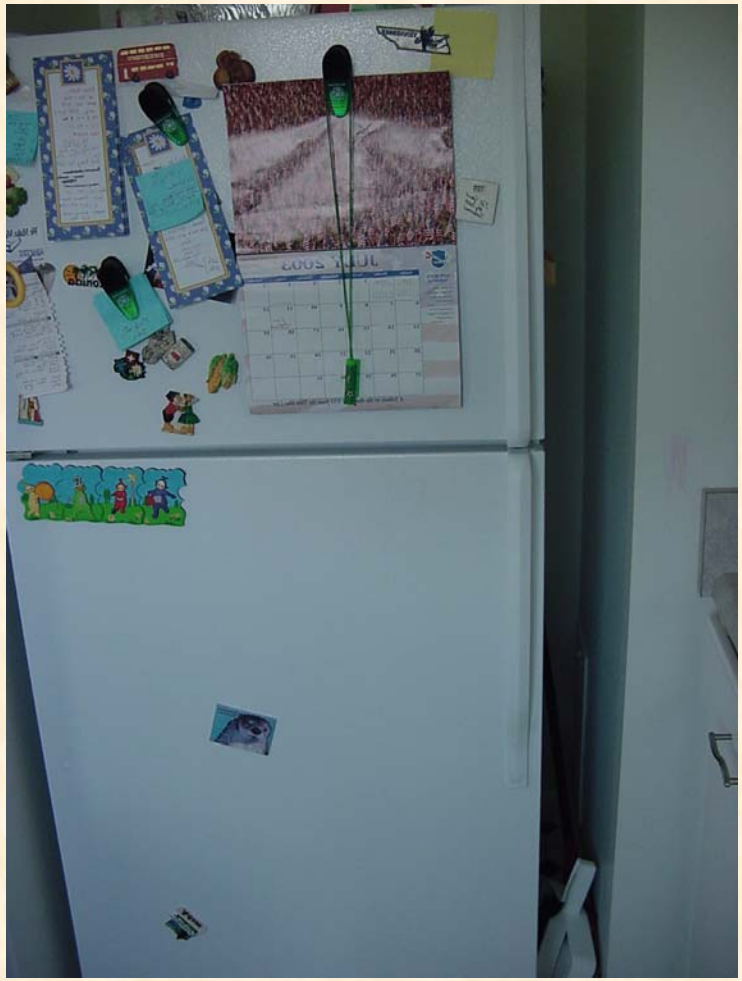
•Annual Energy Outlook 2001, Energy Information Administration, December 2000, Department of Energy, BTS Core Databook, July 26, 2002

ZEH1 Features

- **Integrated HPWH**
- **Heat recovery shower**
- **Energy Star Appliances**
  - **Air-tight floor, wall and ceiling SIPS**
  - **All ducts inside conditioned space**
  - **Mechanical supply ventilation- Air-cycler**
  - **14 SEER - 1.5 ton HP**
  - **Windows .34 U-value, .36 SHGF**
  - **Reflective hidden metal seam roof (light grey)**
  - **Grid-connected 2 kWp PV**
  - **CFL**

Integrated HPWH

During the summer heat comes from behind the fridge



During the heating season the HPWH pulls heat from the earth tempered crawl space

THE SUN
LIGHT FOR ALL
The Sun : Sunday, June 1, 2003 ANNE ARUNDEL Baltimore, Maryland : 50 cents

Habitat for Humanity builds experimental home

ASSOCIATED PRESS
Jeff Christian, director of the building technology center at the Oak Ridge National Laboratory, points to coils used to recover heat from a bathroom shower drain in a special Habitat for Humanity house in Lenoir City, Tenn.

It may be the group's most energy-efficient, all-electric home eve

By DUNCAN MANSFIELD
ASSOCIATED PRESS

LENOIR CITY, Tenn. Kinandjar's bungalow loc any other house in the Ha Heights subdivision — for the 48 solar panels roof and an R2-D2-like heater in a closet.

"I know it is an experi house, but it doesn't bot at all," the 33-year-old w said of the home she mov with her husband and tw dren in October.

The 1,057-square-foot designed by the Departm Energy's Oak Ridge Na Laboratory, may be the m ergy efficient, all-electric ever built by the volu group Habitat for Human

So-called "green buildir growing trend, according National Association of Builders. More than 13,000 homes meeting the association's green building standards were constructed in 2002, compared

parable house across the street, said Jeff Christian, director of the Oak Ridge lab's building technologies center.

solar collectors cost another $24,000.

slightly above conventional construction prices in the area. The

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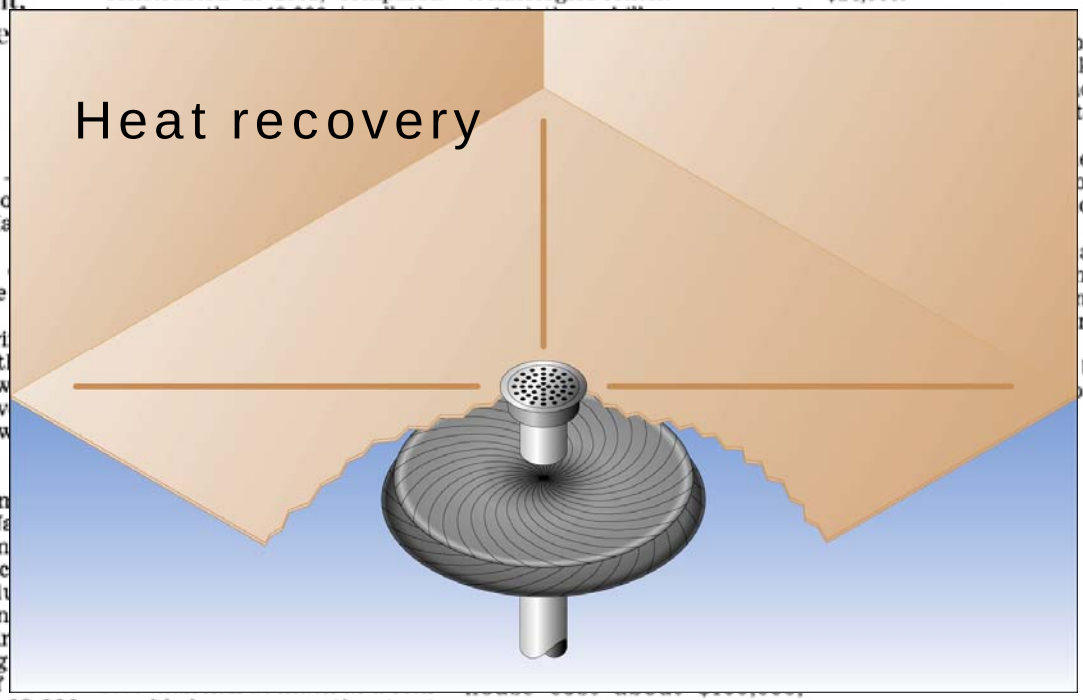


Domestic Hot Water

- **72% of DHW used for showers and baths in ZEH 1**
- **40 gal/day average daily usage; 43% less than found in national HWHP field study in ZEH 1**
- **3.8 kWhr/day average energy; that is 28% less than found in national HWHP field study**
- **Measured COP 1.62 (monthly range 1.52 – 1.88 from Aug 03 to Feb 1) compared to National Field Study of 2.0**

ZEH 2 - $0.78/day

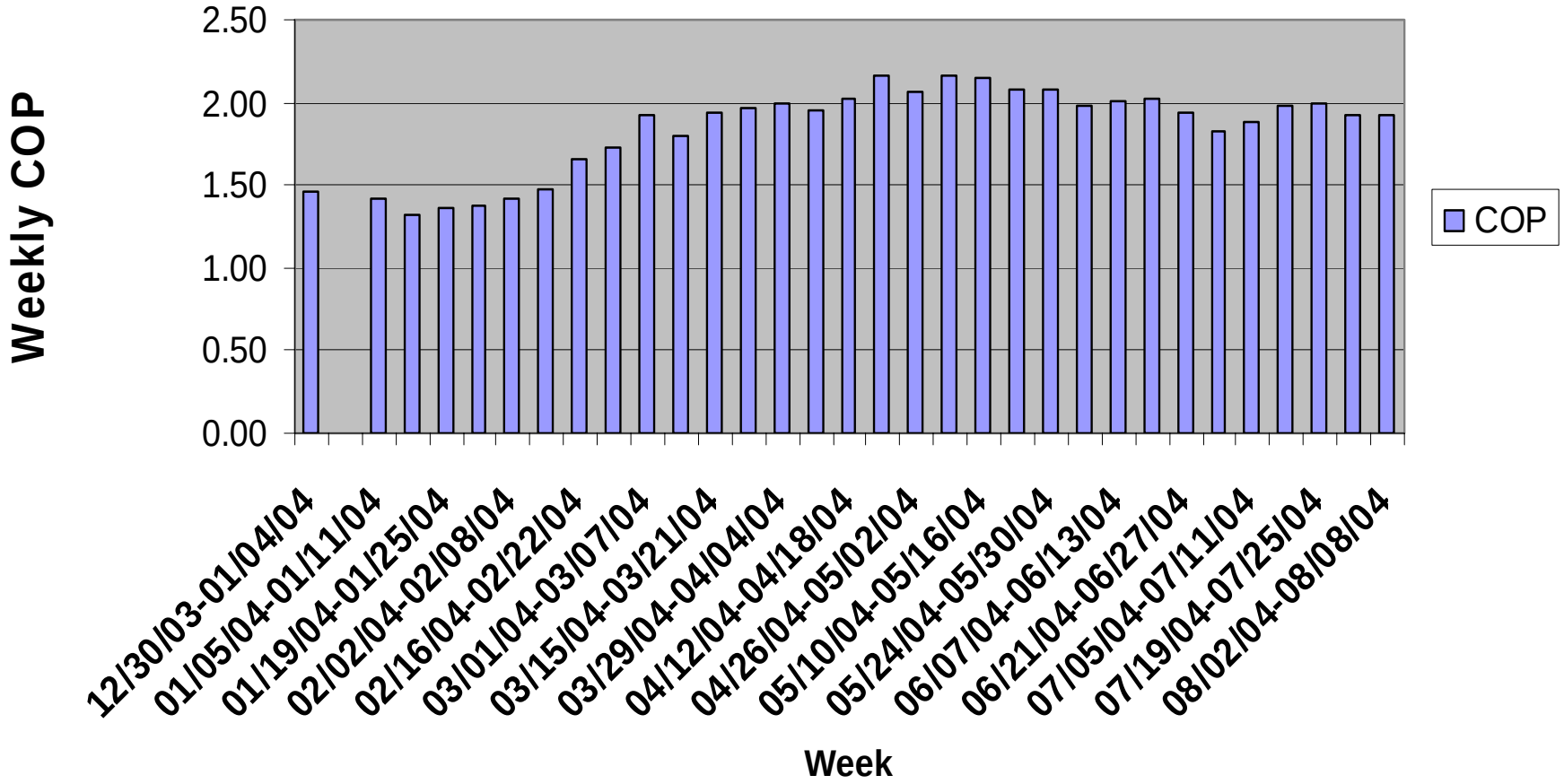
- **HPWH hard duct linked with crawl and fridge on outside wall, COPs of 2.0, pulling from the crawl space.**
- **Occupancy sensor for energy control**
- **R-15.5 walls, R-23 ceiling, SIPs 1.8 lb/ft^3 EPS R-4/in and R-23 floor**
- **2 ton HP two speed compressor, variable speed ECM indoor fan**
- **6/12 pitch, grid-tie 2kWp Sharp 165W Solar PV, 15% efficiency**
- **Insulated-unvented crawlspace**
- **Airtight taped joints with supply mechanical ventilation, preconditioned fresh air.**

Sept. 03, 2003

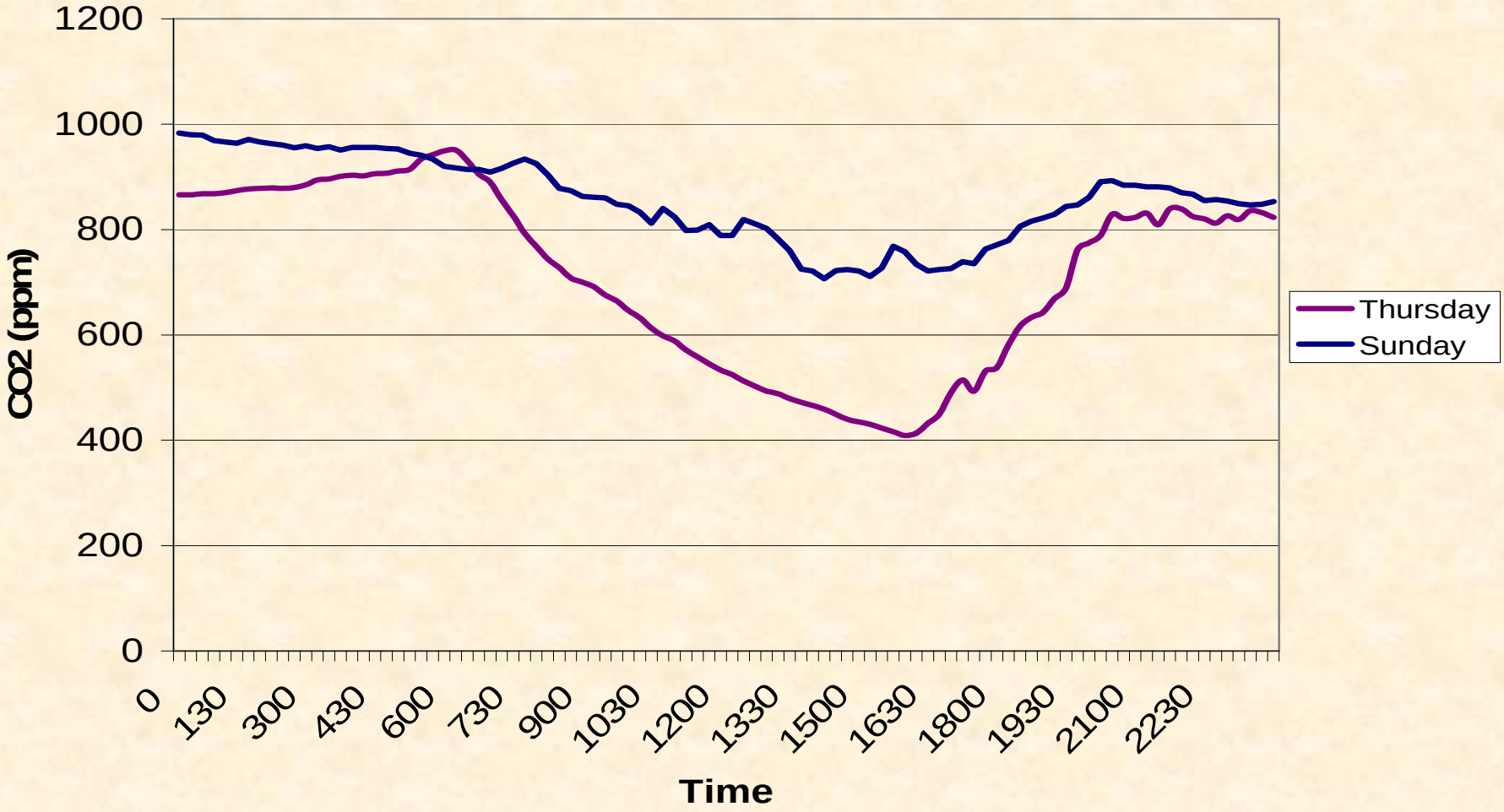
ZEH 2 Integrated Heat Pump Water Heater

- **Located on outside wall**
- **Ducts**
  - **Much shorter**
  - **No flex**
- **HPWH using 2.7 kWh/day(36gal/day)**
- **Fridge using 1.23 kWh/day**

HPWH weekly COPs



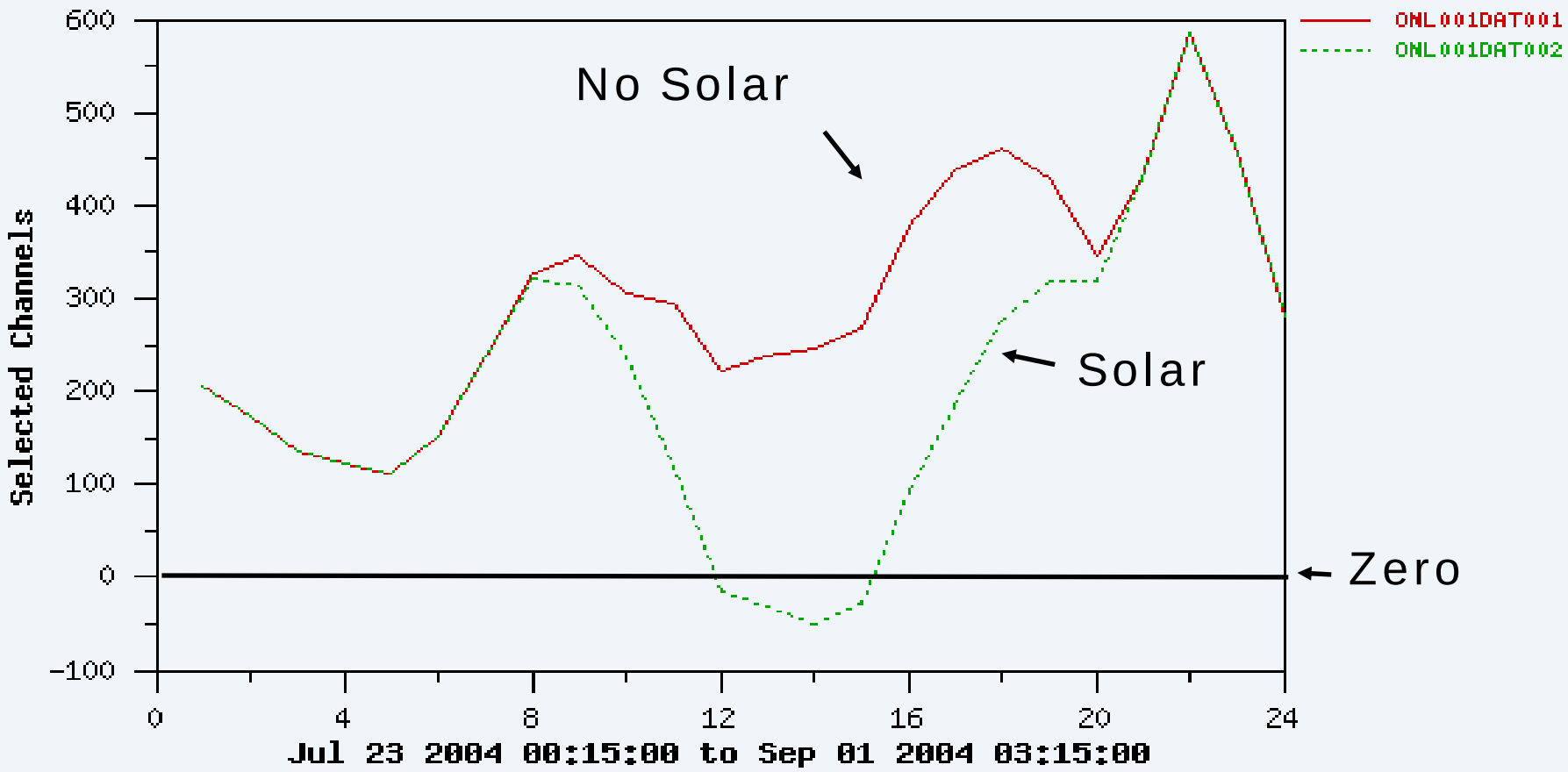
CO_2 Sensor could help reduce Appliance energy loads



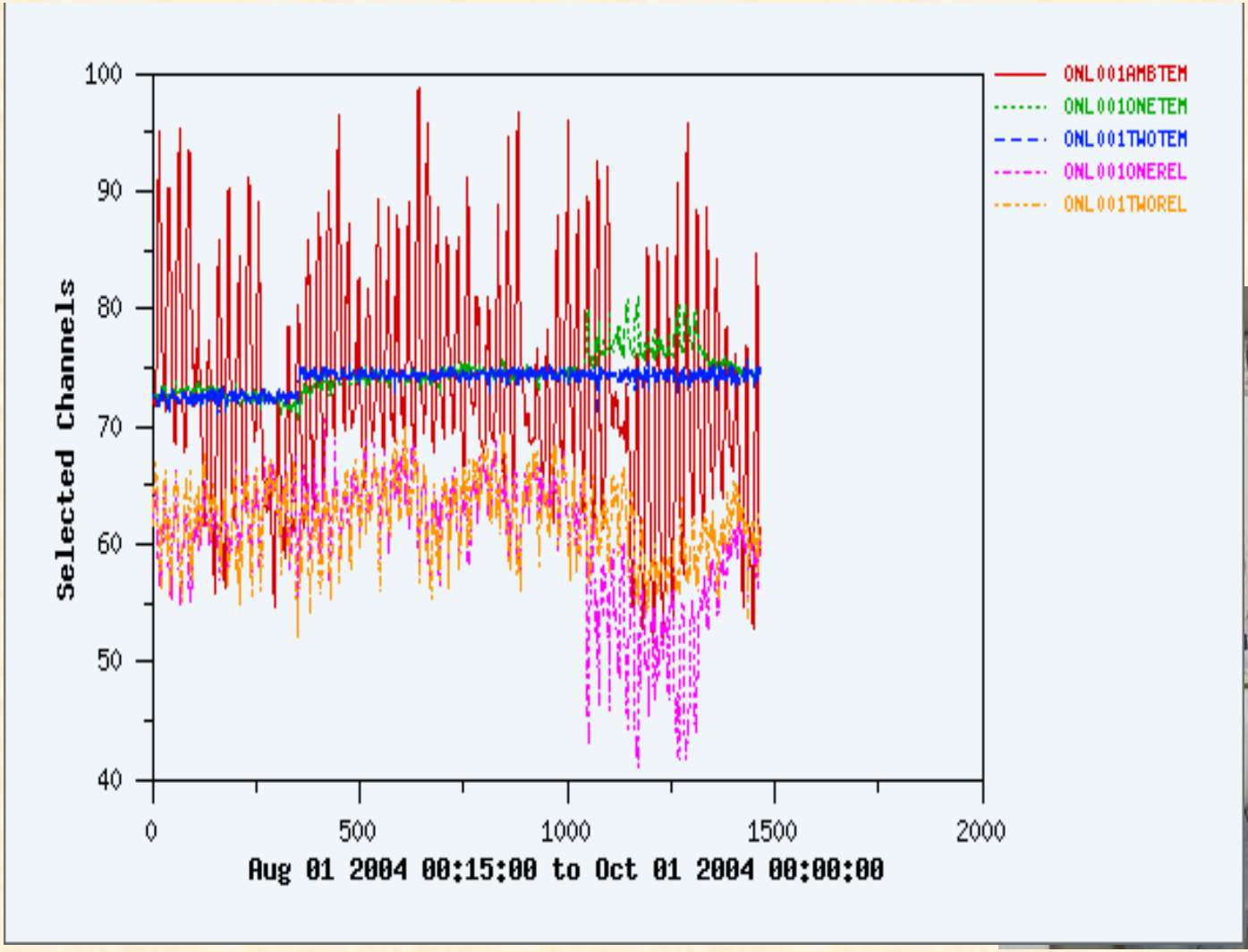
Near ZEH for less than $100k and $0.68/day for off site energy

ZEH4- 2-story bundled kitchen, bath and laundry location in floor plan

ZEH4 PV on average helps meet summer early PM peaks from July 23-August 31, 2004



RH in Summer Months show a key appliance integration opportunity

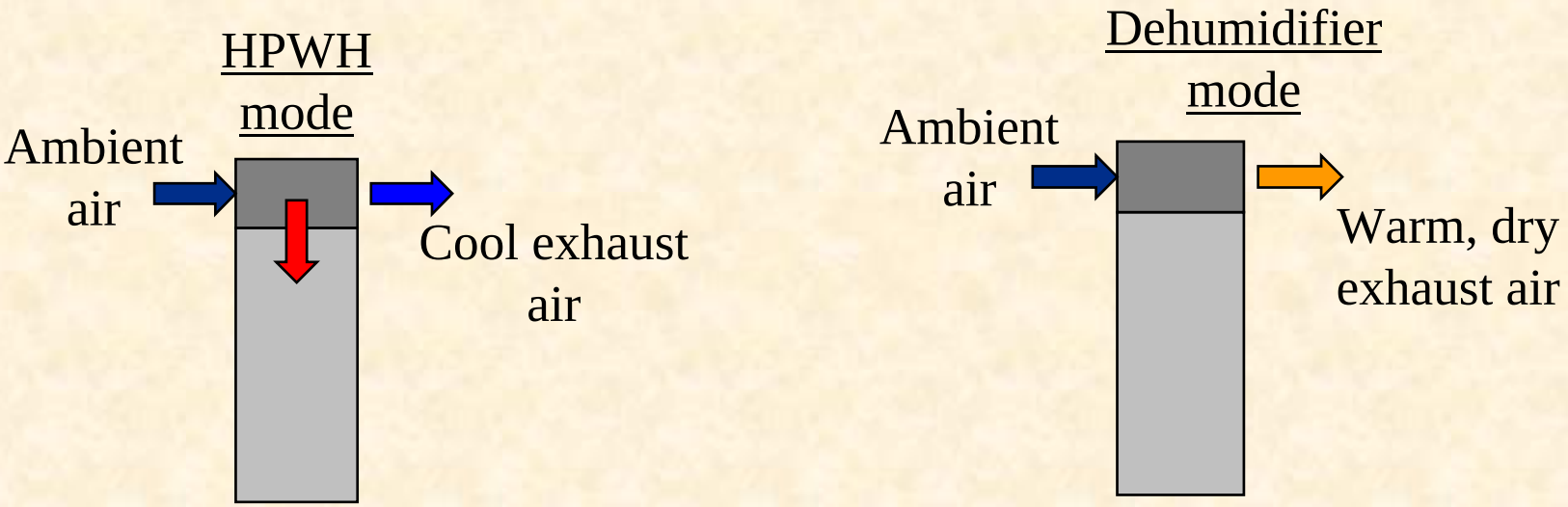


ZEH 5

- **Under design**
- **Solar Hot water?**
- **More aggressive energy efficient appliance integration**
  - **Dehumidifier**
  - **Washer**
  - **Drier**
  - **Dishwasher**
  - **Oven/range**

Appliances Research finds Bern and Boston condominium horizontal-axis washer machine saves 60% energy and 40%water

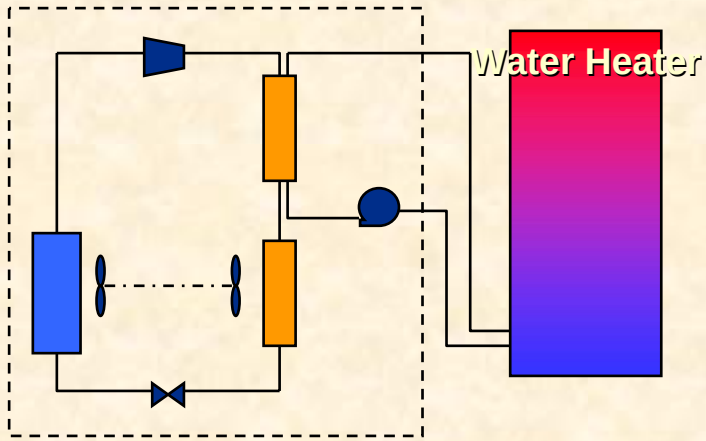
The Water Heating Dehumidifier



Drivers for R&D

- **Buildings**
  - **Becoming tighter**
  - **Fresh air ventilation needed**
  - **Humidity control issue**

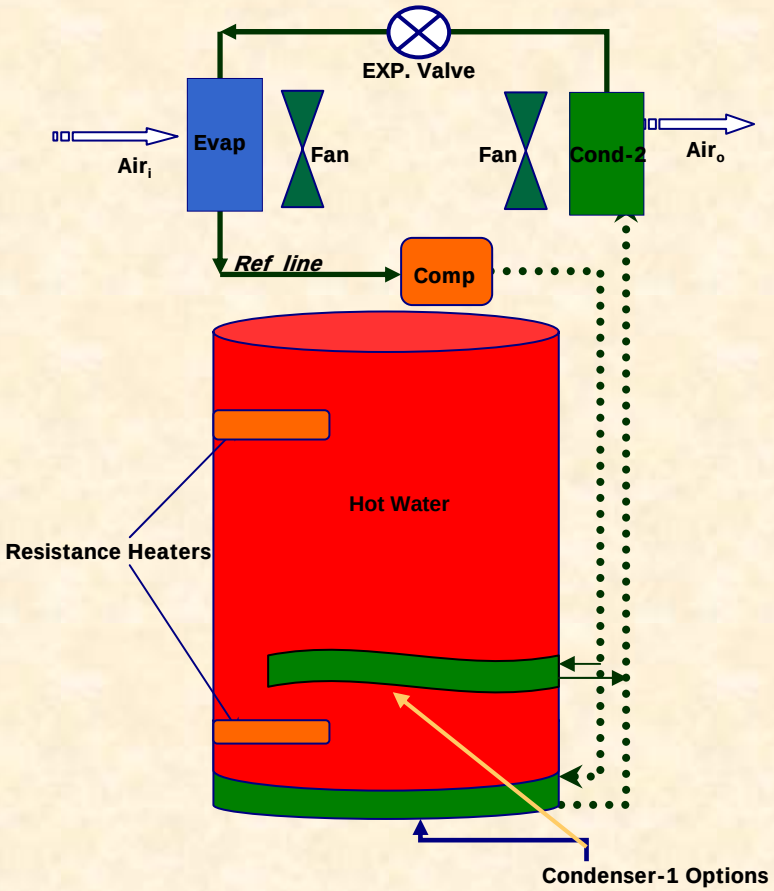
Water-heating Dehumidifier

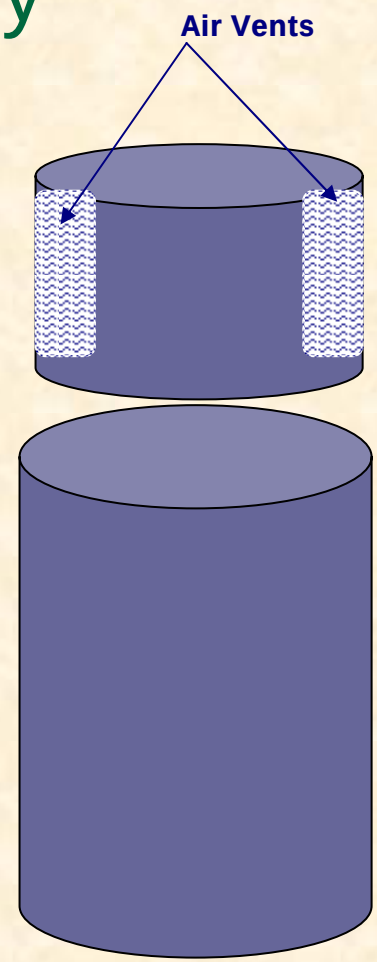


Water-Heating Dehumidifier (WHD)

- Combined appliance: Water-heating dehumidifier
  - Dual (or duplex) condenser technology needed
  - Retrofit-ready
  - Designed to meet dehumidifier EnergyStar rating
  - New product; cuts WH energy consumption by 50%
- Cooperative project with Western Carolina Research Consortium

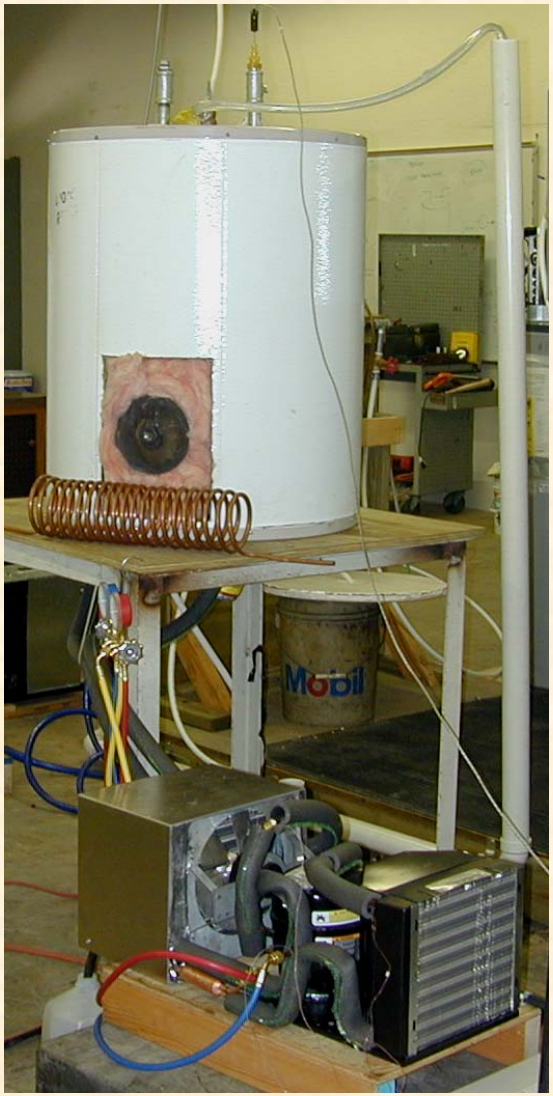
Condenser Options for Water Heating under Study

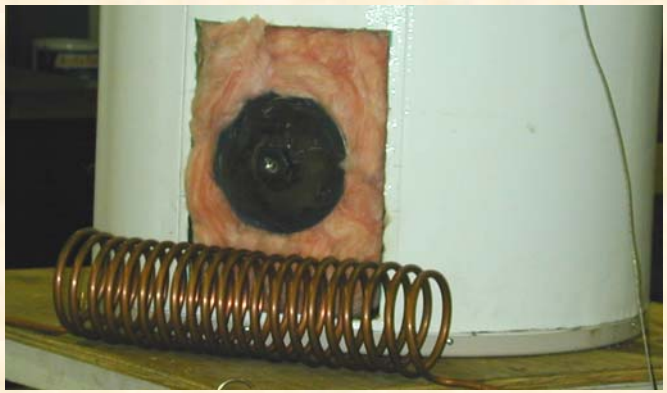




Finish Product

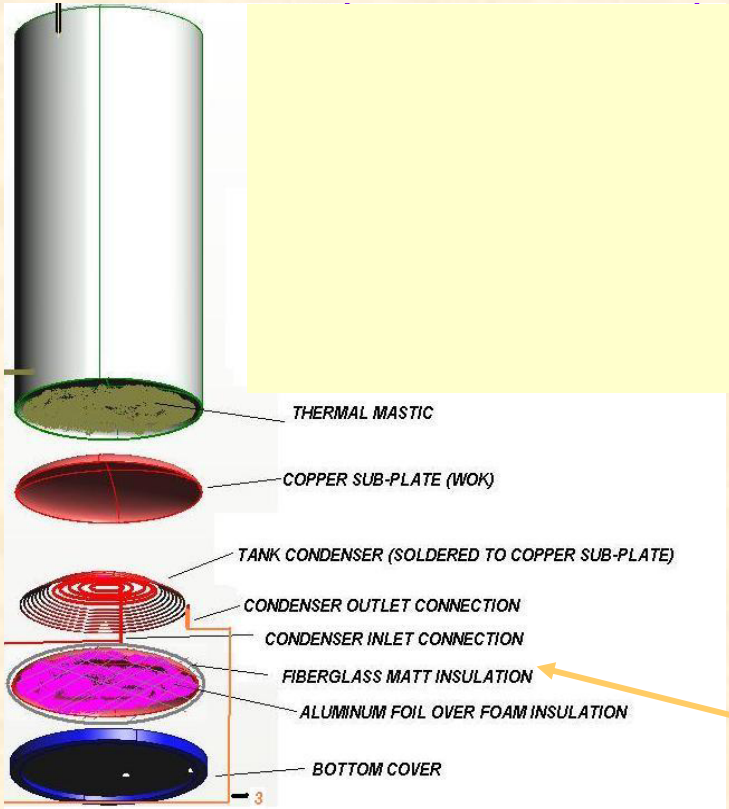
In-Tank Condenser Option

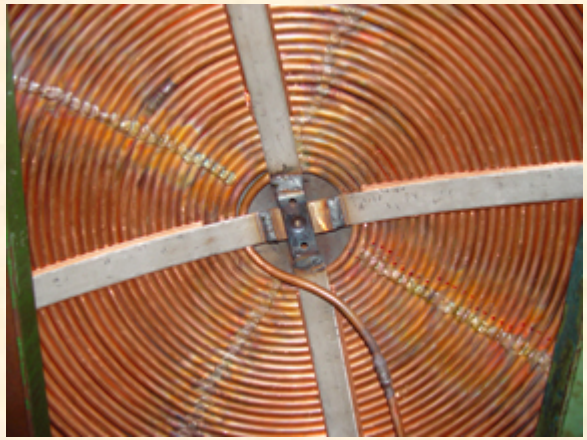




Bottom Condenser Option

support





Mastic Bottom

Plate Bottom

powers that be

The alternative energy scene

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special editions

Little Solar Houses for You and Me

Working to develop the Volkswagen of solar homes

by Amanda Griscom

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07 Oct 2003

Just off I-75 in Tennessee, halfway between Knoxville and Chattanooga, past a Home Depot, a Ford dealership, a Krispy Kreme, and a Piggly Wiggly supermarket, there is a newly developed tract of low-income homes built by volunteers of Habitat for Humanity.

At first glance, nothing about the development seems out of the ordinary. The houses are pleasant one-story colonials with porches, shutters, and carefully trimmed lawns strewn with tricycles and kick balls. But upon closer inspection, the development turns out to be more than just another housing project in sprawling Middle America; it is a testing ground for the affordable, zero-energy homes of the future.

A bright idea: the Indrajaya-Kinandjar solar house.

The most obvious clue to the larger picture -- a two-kilowatt BP Millenia thin-film solar system -- can be seen glinting on the rooftop of the home of Adam Indrajaya and Lina Kinandjar, a landscape worker and pastry decorator, respectively, who moved to Tennessee from Malaysia six years ago. The solar panels were provided by the Tennessee Valley Authority (the public electricity supplier throughout the seven-state region of the Southeast) and the U.S. Department of Energy's Oak Ridge National Laboratory (located just miles away in Oak Ridge, Tenn.), which teamed up with Habitat for Humanity to build this experimental settlement.

Even more impressive than the rooftop installation is the Oak Ridge-designed technology beneath it: special insulated walls, windows, and floors; energy-efficient lighting, appliances, and ducting; and state-of-the-art systems for heating, air conditioning, and hot water. The laboratory also added more esoteric efficiency measures, such as a system that captures the heat from shower water after it goes down the drain, and even one that captures the warmth that comes off the coils behind the fridge.

do good:

Plead for a world run on renewable energy.

>More actions<

>Submit an action<

in the same vein:

Wind it up. A week in the life of Ulla-Britt Reeves, Southern Alliance for Clean Energy.

from the archives:

Grid lock. Lessons from Blackout 2003.
28 Aug 2003

Master of her domain. Julia Louis-Dreyfus and husband Brad Hall discuss their eco-friendly hideaway.
31 Jul 2003

A declaration of energy independence. New clean-energy coalitions talk up national security and the economy.
30 Jun 2003

>More archival matter<

Recent and Upcoming Media Interest

- **This Old House, National broadcasted TV Series, Nov. 04**
- **Cover of the Mother Earth News, Dec. 2004**
- **Two Environmental Film Documentaries, PBS**
- **Business Week**
- **ASHRE Journal, Jan. 05**
- **Forbes**
- **Popular Science**
- **Energy Design Update**
- **Federal Reserve Bank, Partners**

Key technologies for future integration into these near zero energy houses

- **Integrated appliances; refrigerator, dishwasher, oven, washer, dryer, dehumidifier and water heater**

House Kit

1. 50% energy savings from base code complainant housing
2. On site renewable power “ready” to meet 50% of remaining total energy load
3. Potential to meet 50% market penetration into low to medium income new single family site built construction by 2010
4. The building method of choice for affordable, innovative, healthy, productive, durable, energy efficient near net zero energy houses under 2200 ft^2.
5. The kit must be designed to be prefabricated, optimized, and packaged for very fast site assembly
6. The first models are to contain commercially available components
7. Be manufactured in volume to reduce costs and deliver optimal value.

Industry Partners

- Andersen Windows
- SIPA / Insulspan / FischerSIPs) / Winter Panel
- Habitat for Humanity
- TVA
- Dow
- Metal Roofing Alliance/ATAS
- BASF
- Dupont)
- NOVA Chemicals
- Sharp
- Nextech Power/EPRI (DC power)
- Lennox
- Design Basics
- EMI heat pump water heater
- American Geothermal

Energy Star Appliance Partners National Benefits

- "Mass Buy" of a house kit will have appeal to potential home buyers which eventually will display evidence of profitable market for lead production builders
- Provides a vehicle to accelerate introduction of innovative components as they approach market ready stage
- Creates unique manufacturer partnerships across multiple technologies with aggregated buyers of near zero energy house kits.

Jeff Christian

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